A NEW *RICCIISPORITES* FROM THE TRIASSIC OF ARCTIC CANADA

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ABSTRACT. A new plant spore, *Ricciisporites umbonatus* sp. nov., is described. Its occurrence in surface and subsurface is reported. The species appears to occur in Norian and Karnian age rocks.

PALYNOLOGICAL study of Triassic sediments in the Canadian Arctic Islands has resulted in the designation of a new taxon, *Ricciisporites umbonatus*, which is best assignable to the genus *Ricciisporites* Lundblad (1954), 1959. The spore appears to be stratigraphically limited, but it has been observed on numerous occasions from both the surface and subsurface, and is frequently numerous in its representation. We have also recorded it from both marine and non-marine associations.

Triassic rocks are widely distributed in the islands of Arctic Canada, but it has only been in the past two decades that salient features of Triassic stratigraphy have been established. In the Sverdrup Basin, exposures of Triassic rocks occur on Ellesmere, Axel Heiberg, Cornwall, Melville, Prince Patrick, Brock, and Borden Islands, as well as on many smaller islands. The extensive Triassic sediments in the Sverdrup Basin have proved to be of interest as reservoirs for hydrocarbons and have increased in commercial potential. The sediments consist of interbedded marine shales and siltstones and non-marine sandstones, and several distinct facies occur. Detailed correlation of the various sandstones is difficult, and palynological techniques are one of the most promising tools for correlation. Relatively little attention has been devoted to Triassic palynology in the Arctic Islands, and the studies of McGregor (1965), Felix (1975), Fisher and Bujak (1975), and Bujak and Fisher (1976) are the most significant palynology contributions.

The assignment of the new spore to *Ricciisporites* is admittedly speculative. In part identification is based upon a morphological similarity to *R. tuberculatus* Lundblad (1954), 1959, with which it is invariably associated, often in large numbers. In general, the diagnosis is general and brief. The spores have a distal sulcus, and the exine surface has a variety of processes. The major difference from the generic diagnosis is that of tetrad occurrence, since Lundblad (1959) noted that the spores were permanently united into tetrads, and *R. tuberculatus*, the genotype, seems to always occur in a tetrad configuration. *R. umbonatus* usually occurs in single grains, but tetrads were observed. About 10% of the recorded occurrences were tetrads. The presence of both single grains and tetrads in the same family, or even genus, is not unique in fossil or extant plants. The failure to have consistent tetrads in *R. umbonatus* should not deter its assignment to *Ricciisporites*.

The arborescent lycopods have one of the best-known fossil records of the common occurrence of single grains and tetrads. Andrews and Pannel (1942) noted a

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characteristic retention of the tetrad of *Lycospora* in microsporangiate cones of *Lepidocarpon magnificum*. Felix (1954) recorded a frequency of *Lycospora* tetrads in *Lepidostrobus diversus*, but the single-grain feature did seem most common. Felix (1954) and Balbach (1967) found varying degrees of tetrad occurrences in *L. oldhamius* Williamson, 1893 and Brack (1970) reported essentially the same dual spore pattern in *L. schopfi*. *Lycospora* in tetrads and single grains are therefore common components of Pennsylvanian spore floras. Such dual occurrences are extremely common among extant floras. *Typha* of the Typhaceae and *Ludwigia* of the Onagraceae have species which shed pollen in tetrads and others which shed single grains. The Ericaceae are often considered as characteristically having pollen tetrads, but single-grain dispersal occurs in several species in the family. Similarly, species with both single grains and tetrads are found in the Saxifragaceae and Pyrolaceae. Routine laboratory procedures were used in maceration, with all samples initially treated with hydrochloric acid followed by hydrofluoric acid to digest minerals. In most instances a mild oxidation of humic material was undertaken with Schulze's solution. Separation was done by a zinc chloride flotation, and Clearcol was utilized as a permanent mountant.

LOCALITY DATA

Materials for this study came from surface exposures and from well cuttings in the Canadian Arctic Islands, with *R. umbonatus* being present in all samples considered. The associated microflora is given in Table 1.

1. Sun Oil Co. Section no. 77. Surface collections, Oyster River South. Borden Island. Sun Oil Co. Maceration nos. 8571–8575. Schei Point Formation. Karnian.
2. Sun Oil Co. Section no. 78. Surface collections, Oyster River North. Borden Island. Sun Oil Co. Maceration nos. 8597–8603. Schei Point Formation. Karnian.
3. Sun Oil Co. Section no. 81. Surface collections, Intrepid Inlet, Jameson Bay. Prince Patrick Island. Sun Oil Co. Maceration nos. 8917–8920. Heiberg Formation. Norian.
4. Panarctic Gulf *et al.* East Drake I-55 Well. Melville Island. Well cuttings. Sun Oil Co. Maceration nos. 12395 (3750–3780 ft), 12396 (3780–3810 ft), 12397 (3810–3840 ft). Schei Point Formation. Karnian.
5. Panarctic Homestead Hecla J-60 Well. Melville Island. Well cuttings. Sun Oil Co. Maceration nos. 12412 (3680 ft), 12414 (3760 ft), 12415 (3810 ft). Heiberg Formation. Norian.
6. Panarctic Drake Point L-67 Well. Melville Island. Well cuttings. Sun Oil Co. Maceration no. 12540 (3990 ft). Geological Survey Canada Slide C-12263 (4100 ft). Heiberg Formation. Norian.

SYSTEMATIC DESCRIPTION

Anteturma SPORITES H. Potonié, 1893
Turma PLICATES (Naumova, 1939) R. Potonié, 1960
Subturma MONOCOLPATES Iversen and Troels-Smith, 1950
Genus RICCIISPORITES (Lundblad, 1954) emend. Lundblad, 1959

Type species. *Ricciisporites tuberculatus* (Lundblad, 1954) emend. Lundblad, 1959.

Ricciisporites umbonatus sp. nov.

Plate 65, figs. 1–19

Diagnosis. Spores oval to elongate. Sulcus irregular, not clearly defined and often represented by elongate, thin exinal area. Body minutely granulose, wall distinct, 1·5 μm–3·5 μm thick. Sculptural elements vary, usually of prominent rounded processes from 4 μm to 13 μm in diameter, but with variations in shape and size to large verrucae 10 μm × 24 μm. Infrequently in tetrads.

Dimensions. (Sixty-five specimens.) Over-all equatorial diameter 40 μm × 45 μm–68 μm × 70 μm. Diameter of spore body 26 μm × 33 μm–41 μm × 56 μm. Rare specimens observed with over-all dimensions of 30 μm × 35 μm and 65 μm × 95 μm but are regarded as aberrants. Tetrad size 75 μm × 80 μm–85 μm × 90 μm.

Holotype. Slide 8920-1. Location 44·9 × 112. Plate 65, fig. 1. The holotype has been deposited in the collection of the United States National Museum of Natural History, under catalogue no. 240061 from USNM Catalogue no. 36. The type specimen has been ringed with a diamond-point engraving objective to further facilitate location.

TABLE 1. Associated Microflora.

	Surface			Subsurface		
Localities	1	2	3	4	5	6
Ricciisporites tuberculatus	×	×	×	·	·	·
Zebrasporites interscriptus	×	×	×			
Ovalipollis ovalis		×	×	×	·	
Ovalipollis breviformis			·		·	
Limbosporites lundbladii			×		×	
Protodiploxypinus sp.	×	×	×	×	×	·
Brachysaccus sp.	×	×	×	×	×	·
Sverdrupiella usitata				·	×	·
Sverdrupiella baccata				·	×	
Sverdrupiella ornaticingulata				·	×	
Sverdrupiella septentrionalis				·		
Sverdrupiella manicata					×	

Description. Holotype 67 μm × 69 μm over all. Body diameter 50·5 μm. Wall distinct, 3·5 μm thick. Surface-bearing globular processes with diameters 9–12 μm. Processes scattered, about fifteen around body periphery. Spore body minutely granulose, with ill-defined, irregular sulcus.

Remarks. The surface ornament is usually of prominent globose excrescences of fairly uniform size and shape. Some variations exist such as small diameters (Pl. 65, fig. 12), and occasional clavate or pilate shapes. There are rare examples (Pl. 65, figs. 15, 18, 19) which would appear too diverse in ornamentation for inclusion in *R. umbonatus*, but specimens exist which show transitional characters to these forms. The exinal protuberances may vary with specimens having both rounded ornamentation and verrucae development (Pl. 65, fig. 15). Greatly enlarged, irregularly shaped ornament features are present such as Plate 65, fig. 19, where only five protuberances developed. A trend also exists to near verrucate, flanged morphology (Pl. 65, fig. 18). These departures from the typical morphology are scarce and could represent aberrants. They are so rare and so variable that further taxonomic division seems inappropriate. Much the same variability exists in the well-known *R. tuberculatus* but is little noted in the literature. Geiger and Hopping (1968) noted considerable variability within *R. tuberculatus*, with at least four variants present. Schulz (1967) observed wide size and sculpture variations in *R. tuberculatus* but considered division into more species inappropriate. The sulcus is not easily observed, usually being obscured by the processes, and still ill defined on denuded specimens (Pl. 65, fig. 8). Often it appears as a thinning in the exine and of irregular shape, but it is a consistent feature on most specimens.

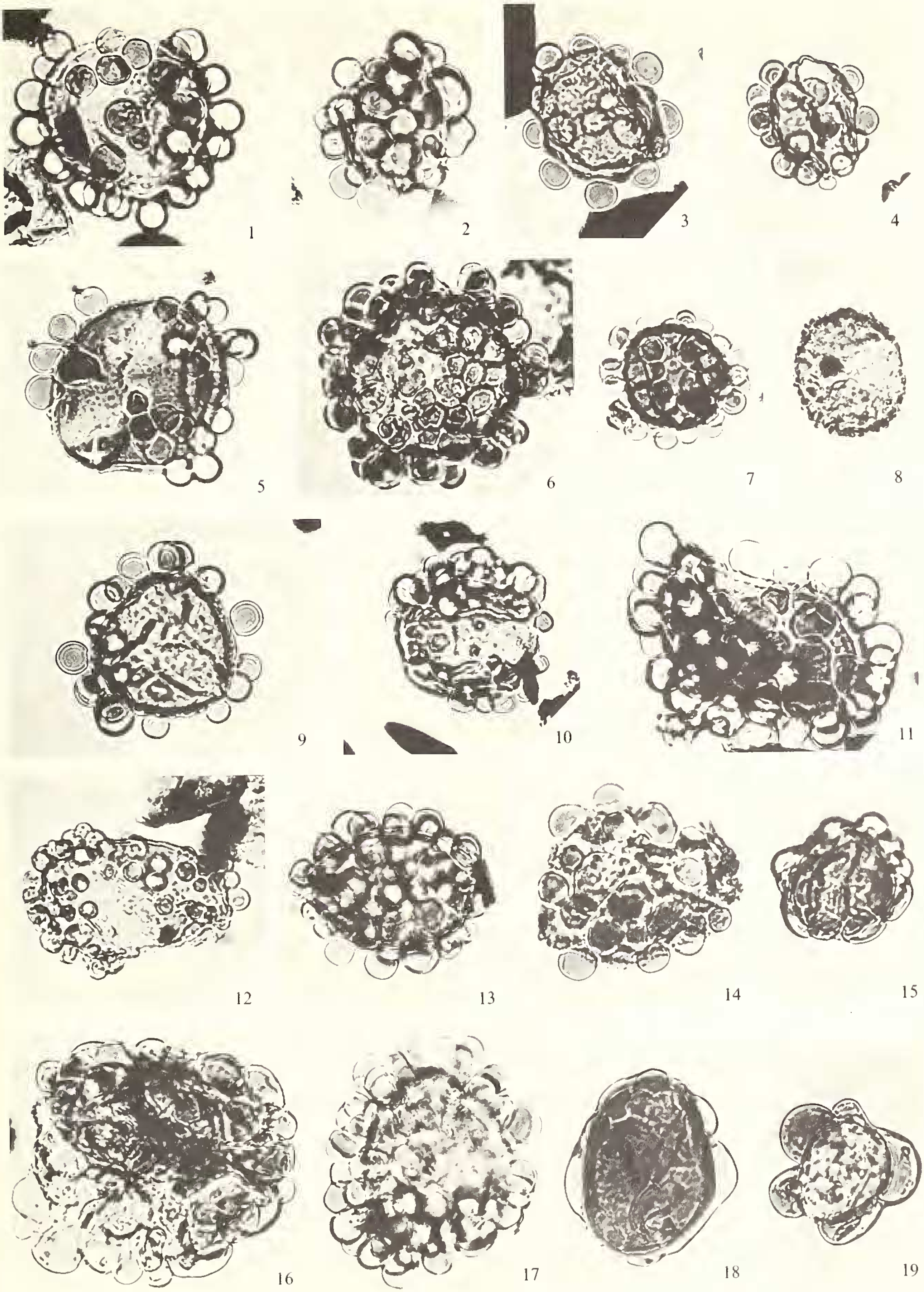
Ornamentation composed of tubercules or rounded verrucae somewhat similar to those of *R. umbonatus* are known for other miospores, but there does not appear to be any close comparison with other described taxa. There is some resemblance in ornament to *Lophozonotriletes lebedianensis*, described from the Famennian of the Russian Platform by Naumova (1953), and Devonian entities are commonly recycled into Arctic Mesozoic sediments. However, the Devonian representatives are easily differentiated, and the preservation and association characteristics of *R. umbonatus* indicate its indigenousness to the Triassic. *L. lebedianensis* is also clearly trilete, whereas *R. umbonatus* is consistently sulcate and never displays a trilete character.

STRATIGRAPHICAL OCCURRENCE

The exact stratigraphical placement of *R. umbonatus* is somewhat conjectural, as is often the case in a comparatively new area of investigation and when dealing with such large areal extent as the Canadian Arctic. We have observed the spore in common association with several taxa characteristic of the Upper Triassic (Table 1). When collecting the surface sections considered here, we regarded the field samples in which *R. umbonatus* is present as being representative of the Schei Point Formation and of Karnian age. However, as our subsurface studies progressed, the association of *R. umbonatus* in wells has been with marine microplankton successions, which Fisher and Bujak (1975) have regarded as entirely or certainly mostly of Norian age.

EXPLANATION OF PLATE 65

Figs. 1–19. *Ricciisporites umbonatus* sp. nov. All figures ×500. 1, holotype; slide 8920-1, location (44·9 × 112); 2, specimen with large, densely concentrated tubercules, occurring commonly; slide 8920-1, location (21·7 × 119·9); 3, small, partially denuded specimen with granulose body and sulcus area visible; slide 8920-2, location (35·5 × 113·5); 4, small specimen with sparse tubercules and minimum over-all diameter for species, sulcus visible, occurring sparsely; slide 8920-2, location (13 × 122·2); 5, partially denuded large specimen with granulose body and sulcus area visible; slide 8920-1, location (40 × 116·4); 6, large specimen with densely concentrated tubercules and maximum over-all diameter for species; slide 8920-2, location (41·1 × 118); 7, small specimen with uniform tubercule distribution; slide 8920-2, location (38 × 112·9); 8, isolated, granulose body, sulcus visible; slide 8920-1, location (39·9 × 116); 9, partially denuded specimen with granulose body and sulcus area visible, occurring commonly; slide 8920-2, location (34·5 × 120·5); 10, partially denuded specimen with sulcus visible; slide 8920-2, location (27·8 × 116·5); 11, large, distorted specimen, occurring rarely; slide 8920-1, location (24·8 × 123·8); 12, partially denuded specimen, occurring rarely, with very small diameter tubercules; slide 8920-2, location (48·5 × 114); 13, commonly occurring sub-surface form; slide 12395-1, location (41 × 122); 14, commonly occurring form; slide 8920-1, location (21·6 × 119); 15, rare, probable aberrant, with sulcus visible, tubercules irregular; slide 8920-2, location (39·5 × 108); 16, tetrad, with large, densely concentrated tubercules; slide 8920-2, location (36·5 × 115·1); 17, tetrad, with normal tubercule configuration; slide 8920-2, location (40 × 109·1); 18, rare, probable aberrant, irregular tubercules forming verrucae and incomplete flange; slide 8920-2, location (37·5 × 115); 19, rare, probable aberrant, massive irregular tubercules, sulcus area visible; slide 8920-1, location (31·8 × 120·2).



FELIX and BURBRIDGE, *Ricciisporites* from the Trias

A comparison of the surface and subsurface successions is difficult since the surface materials containing *R. umbonatus* are non-marine, whereas the subsurface samples occurred in marine beds. Therefore precise control is difficult to establish with such varied environmental conditions.

Our surface collections have some associations with fossil faunas and lithological sequences that offer some stratigraphical clarification. A prominent feature of the Schei Point Formation is the presence of an Upper Karnian 'Gryphaea Bed' (Douglas 1970, p. 578). This consists of a thick calcareous sandstone with coquinoid layers of *Gryphaea* and *Plicatula*. This bed marks the top of the Schei Point Formation in central Ellesmere Island and is also present on Prince Patrick and Borden Islands. A prominent coquina bed, assumed to be the same one, is present in all three of our surface sections. In Sections 77 and 78 *R. umbonatus* has its occurrence within the limits of the coquina bed. In Section 81 *R. umbonatus* occurs immediately above the coquina bed. The conclusion, therefore, is that *R. umbonatus* is Upper Schei Point (Karnian) in Sections 77 and 78 from Borden Island. It has a Lower Heiberg (Norian) occurrence in Section 81 from Prince Patrick Island. The reasoning for Fisher and Bujak (1975) considering their subsurface dinoflagellate assemblage to be Norian seems valid. Accordingly, the common association of *R. umbonatus* with these dinoflagellates in wells would indicate the spore's subsurface presence to be Norian. Present evidence does not indicate that *R. umbonatus* occurs in Rhaetian age sediments, but that it is presently found in Lower Heiberg Formation (Norian) and Upper Schei Point Formation (Karnian) sediments. The fact that there is still no corroboration of marine and non-marine sediments and considering the actual limited range of Arctic studies, additional range extension of *R. umbonatus* is not precluded. Further studies may well warrant changes in these premises.

ASSOCIATED MICROFLORA

All of the assemblages contained numerous bisaccate pollen, and most seemed assignable to *Protodiploxipinus* (Samoilovich) Scheuring, 1970 and *Brachysaccus* Mädler, 1964. The *Protodiploxypinus* includes *Minutosaccus* Mädler, 1964, and species represented include *P. gracilis*, *P. potoniei*, and *P. schizeatus*. The bisaccate grains occur in such numbers and variety as to be beyond the scope of this study. However, they appear to be an integral part of the populations, and they did not occur in association with Rhaetian assemblages in the localities treated here.

Table 1 lists the more prominent taxa occurring in association with *R. umbonatus*. Preservation was good, and *R. tuberculatus* in both surface and subsurface and *Sverdrupiella* Bujak and Fisher, 1976 in the subsurface were generally well represented. Such generally diagnostic Upper Triassic representatives as *Cornutisporites seebergensis* Schulz, 1967, *Triancoraesporites communis* Schulz, 1967, *Rhaetipollis germanicus* Schulz, 1967, *Rhaetogonyaulax rhaetica* (Sarjeant, 1963), Davey, Downie, Sarjeant, and Williams 1966, and *Semiretisporis* Reinhardt, 1962, which we have observed frequently in Arctic studies, are not present in these samples. They have been common in other areas of Upper Triassic interest, and their association has always appeared to be Rhaetian age. *Ricciisporites tuberculatus* was a common entity, and it was usually numerous in all localities. The bisaccates, encompassing a variety of *Brachysaccus* and *Protodiploxypinus* were also prominent in all six localities. *Zebrasporites interscriptus* (Thiergart) Klaus, 1960 was noted only from the surface localities. *Sverdrupiella* was usually numerous in the subsurface samples, with *S. usitata* Bujak and Fisher, 1976 being the most common representative. Despite diligent surveillance, *Sverdrupiella* was never observed in surface sections, and the occurrences of *Sverdrupiella* treated by Fisher and Bujak (1975) and Bujak and Fisher (1976) from the Arctic Triassic are all from subsurface deposits.

LOCATION OF SPECIMENS

The exact field position of specimens is noted in the plate explanation as co-ordinates in parentheses. The reference point co-ordinate of 5×120 is marked on each slide to assist in locating specimens.

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